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Brief 66-10084

NASA TECH BRIEF

Refractory Coating Protects Intricate Graphite Elements from High-Temperature Hydrogen

The problem:

To provide a refractory protective coating for graphite heater elements operating at temperatures as high as 3500°F for at least one-half hour in a hydrogen atmosphere. The intricate shape of the elements prevents application of a refractory coating by the vapor-deposition process. Uncoated graphite elements will be attacked at temperatures above approximately 2500°F.

The solution:

A composition, containing powdered tungsten, that is painted on the graphite elements and heat-treated to form a tightly adherent 3-mil-thick refractory coating.

How it's done:

The graphite heater elements are painted with a thin coat of a mixture containing the following ingredients, in parts by weight: 10 to 30 tungsten powder (325 mesh), 2 carbon black, 9 commercially available phenol-formaldehyde varnish or paint, and 0.4 maleic anhydride. The coated parts are then cured in air over the following time-temperature cycle: from room temperature to 100°C in 1 hour, at 100°C for 1/2 hour, and from 100° to 250°C in 3 hours at the rate of 50°C per hour. Following the curing cycle, the coated heater elements are baked in a 10^{-2} torr vacuum while the temperature is raised from room temperature to 850°C at the rate of 50°C per hour. The coated parts are then connected as electrical resistive loads in an atmosphere of pure methane and supplied for 2 minutes with 216 watts of power per square inch of exposed area. This treatment produces a carbonaceous crust, which is brushed off after the power is turned off. The process is completed by placing the parts in an atmosphere consisting of hydrogen and methane (5% by volume) at 200 psia and applying the electrical power at a rate increasing steadily from 226 watts to 344 watts per square inch in one hour.

Notes:

1. A coating of 3 mils thickness heated to 4000°F has withstood a hydrogen atmosphere for half an hour, with no apparent degradation.
2. This process, which is simpler and less costly than the vapor deposition process, can be used to protect graphite parts for induction furnaces. It may also have application in semiconductor technology.
3. Inquiries concerning this invention may be directed to:

   AEC-NASA Space Nuclear Propulsion Office
   U.S. Atomic Energy Commission
   Washington, D.C., 20545
   Attn: Technology Utilization Branch
   Reference: B66-10084

Patent status:

No patent action is contemplated by NASA.

Source: C. E. Vogel, J. R. Ferris, R. L. Patterson, and R. J. Steffen of Westinghouse Astronuclear Laboratory under contract to AEC-NASA Space Nuclear Propulsion Office (NU-0027)

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